PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Apparatus for Dispersing Suspensions of Solid Particles to Colloidal Fineness

We JAN KASPAR, of No. 1332, U kostelicka, pardubice, Czechoslovakia, VLADISLAV BICIK, of No. 150, Stavbaru, Pardubice, Czechoslovakia, JOSEF SOUDEK, of No. 1293, Sezemicka, Pardubice, Czechoslovakia and STANISLAV POKORNY, of No. 467, Druzstevni, Kyje U Prahy, Czechoslovakia, all citizens of Czechoslovakia, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus for dispersing suspensions, in particular to apparatus for dispersing suspensions up to colloidal fineness by action of impacts caused in a mechanically agitated mixture of milling bodies and a suspension to be treated.

The finish of solid materials being in the form of suspensions to a particle size amounting from a few microns up to tenths of microns is carried out in various kinds of apparatus, whereof the so called sand mills are the best known.

In the latter the dispersing effect is attained by the combined effect of impacts and friction of the milling bodies intensively stirred mechanically with the suspension in a vertical cylindrical vessel. With regard to resistance to abrasion, plate disks are generally used as the stirring device. Fig. 1 of the accompanying drawings represents an apparatus of the kind previously used consisting of a vessel 1, stirrer 2, intake neck 3 for the suspension supply, screen 4, and neck 5 for the discharge of the treated suspension.

The suspension to be milled is continuously fed in through the neck 3 on one side of the vessel 1, and led away through the screen 4 by the neck 5 on the other side of the vessel. The milling bodies are retained, by the screen, in the vessel.

The dispersing effect is dependent, among other things on the size of the milling bodies, on the ratio between the quantity of the bodies to the quantity of the suspension, on the viscosity of the latter, and on the intensity of agitation. The flow rate of the suspension through the screen is directly dependent on pressure, size of the screen mesh, and indirectly dependent on the viscosity of the suspension.

There are known sand mills in which the cover is open, so that the suspension is forced through the screen only by the action of the hydrodynamic pressure derived from the rotation of the contents of the vessel.

It was found that dispersion proceeds according to the relation:

$$U_d = 1 - (1 + U_{d_0}) \cdot e^{-\lambda\tau}$$

wherein

U_d = cumulative frequency of particles smaller than the size *d*,

U_{d_0} = starting cumulative quantity of dispersed particles,

τ = time of dispersing

λ = the dispersion constant, given by the relation

$$\lambda = K_p \frac{P}{\sqrt[3]{\frac{2}{3} \cdot \frac{p+1}{p}} - 1}$$

in which the general dependence between the constant λ and the ratio p of the quantity of dispersing bodies to the quantity of the suspension has been derived; this dependence is illustrated in Fig. 3 of the accompanying drawings. There holds for the section 0—1 the ratio shown in the equation for the dispersion constant λ or in the equation K is a constant.

With respect to the constant K_p, the intensity of dispersion depends on the size D of the grinding particles, on the ratio p between the quantity of particles to the quantity of suspended matter, on the viscosity η of the suspension, on the mixing intensity, described for instance by the peripheral velocity v of the disks, on the particle size d of the ground material and upon the specific properties ρ of the ground material.

The dispersion constant λ is used for evaluating the intensity of dispersion. From a general point, the following function will apply.

$$\lambda = r(p, D, \eta, d, v, \rho)$$

If, during the dispersion tests, only the value p is changed without changing the other values, then the above expression will have the following form:—

$\lambda = K_p \cdot g(p)$ wherein the constant K_p represents the following function:

$K_p = h(D, \eta, d, v, \rho)$ wherein the chosen values of the variable values are substituted. The letter p serves as index to the constant K_p.

It was found that the contents in a vertical vessel are not perfectly mixed within all the space, so that the ratio of the quantity of milling bodies to the quantity of suspension is substantially higher in the bottom part than in the upper part of the apparatus. This circumstance very unfavourably influences the dispersing intensity since it is only in the upper part of the space that optimum conditions exist. Therefore the output of such a dispersing apparatus is always inferior to what it would be under optimum conditions.

Furthermore it was found that on stopping the stirrer, the milling bodies settled down to the bottom, and that it was necessary to increase the power of the electric motor substantially during the time before attaining equilibrium conditions, which time takes from minutes up to tens of minutes. These difficulties increase with increase in the size of the apparatus.

It is an object of the present invention to obviate or mitigate the abovementioned drawbacks. The present invention is an apparatus for dispersing suspensions up to colloidal fineness by action of impacts caused in a mechanically agitated mixture of milling bodies and a suspension to be treated, which apparatus comprises a cylindrical vessel provided with end covers and with an inlet for suspension intake, the axis of the vessel and of a shaft provided with disks or other stirring devices being horizontal or inclined at an angle of up to 45°, to the horizontal the shaft being sealed by means of a sealing box.

An embodiment of the present invention will now be described, by way of example, with reference to Figs. 2, 4, 5 and 6 of the accompanying drawing, in which:—

Fig. 2 is a diagrammatic sectional elevation of the apparatus according to the invention; and

Figs 4, 5 and 6 are elevations similar to Fig. 2 but incorporating modifications according to the invention.

The apparatus, as shown in the drawings, consists of a vessel 1 with fixed covers 2 and 11. The cover 2 is provided with a sealing box 3 packing a shaft 9, and with a neck 4 for the intake of the suspension to be treated. The vessel is also provided with a wide neck 5, into which a box 6 with a screen 7, and a pipe 8 for discharge of the milled suspension, are inserted. On the shaft 9 are provided disks 10 or another stirring device may be used. The axis of the vessel is horizontal or slightly inclined at an angle of up to 45° to the horizontal. The intensity of stirring, and consequently the specific volume output of the apparatus, can be further substantially increased by building into the vessel 1, between each pair of rotating disks 10, a pair of fixed dished disks 12 (Fig. 4), or a single fixed flat disk 13 (Fig 5) or a rod or arm 14 (Fig 6). The parts 12, 13 and 14 serve to give the stirred mixture a more distinct direction of flow and/or to reduce the rotational speed of the contents of the vessel. The rods 14, which project across the interior of the cylindrical vessel, enhance the intensity of the stirring effect.

The operation of the apparatus is as follows:—

The suspension to be milled is fed into the vessel 1 through the neck 4, and is intensively mixed by the stirring disk 10 together with the bodies. After having passed through the apparatus, the suspension passes through the screen 7 into the space of the box 6, wherefrom it is led away by the pipe 8. The milling bodies are retained by the screen being then remixed with the content of the vessel.

The above described arrangement can be applied so that the screen through which the suspension is passed is fixed to the cover 11, or alternatively inserted, in cylindrical form into the vessel 1 close by the cover 11. The arrangement as shown in Fig. 2 is advantageous from the viewpoint of manipulation in checking or exchanging the screen. The principal advantages of the arrangement are: Optimum conditions for dispersing are secured within all the space of the apparatus so that a higher dispersing effect is attained. Owing to the uniform sedimentation of the milling bodies the stirring of the content of the apparatus in the individual milling zones is easier, so that a motor of lower power is sufficient. The specific volume output of

the apparatus is much less dependent on the size of the apparatus which circumstance affords practically unlimited choice of the size of apparatus according to the desired output.

The subject of the invention is thus an apparatus serving for dispersing suspensions up to colloidal fineness by the action of impacts caused in a mechanically stirred mixture of milling bodies and the suspension to be milled, which apparatus consists of a cylindrical vessel such as L provided with covers 2 and 11, with a shaft 9 and stirrers 10 having an intake neck 4 for the supply of suspension, sealing box 3, a wide neck 5, and a box 6 with a screen 7, wherein the axis of the vessel 1 and of the shaft 9 is horizontal or inclined at a slope of up to 45°. The invention relates further to the abovedescribed apparatus which may be provided in addition with disks 12 or 13, and/or with rods 14.

WHAT WE CLAIM IS:—

1. An apparatus for dispersing suspensions up to colloidal fineness by action of impacts caused in a mechanically agitated mixture of milling bodies and a suspension to be treated, which apparatus comprises a cylindrical vessel provided with end covers and with an inlet for the suspension intake, the axis of the vessel and of a shaft provided with discs or other stirring devices being horizontal or inclined at an angle of up to 45°, to the horizontal the shaft being sealed by means of a sealing box.

2. An apparatus according to claim 1, in which the vessel is provided with a wide-necked outlet into which is inserted a box provided with a screen, and with a discharge pipe for leading away the milled suspension.

3. An apparatus according to claim 1 or claim 2 in which the vessel is provided with fixed disks and/or with rods projecting across the interior of the cylindrical vessel.

4. Apparatus substantially as hereinbefore described with reference to, and as illustrated in Figs. 2, 4, 5 and 6 of the accompanying drawings.

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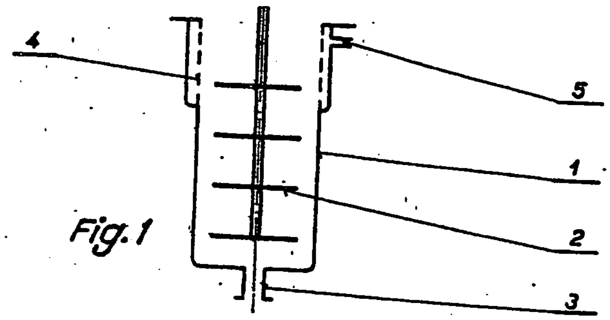

Fig. 1

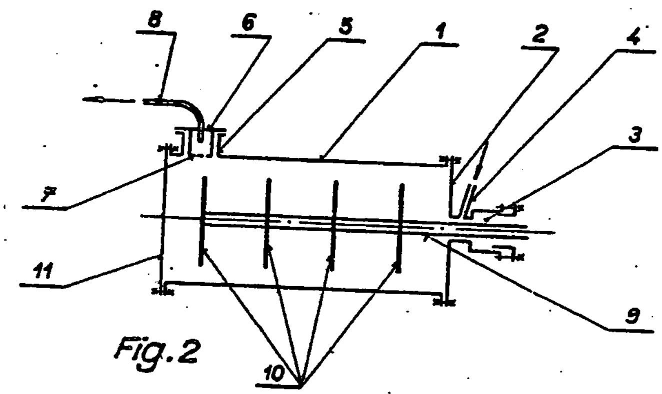

Fig. 2

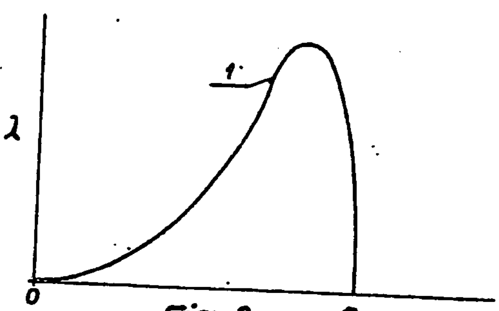

Fig. 3

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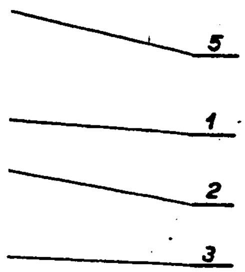
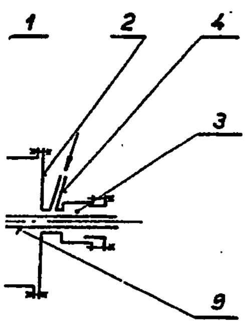
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheets 1 & 2





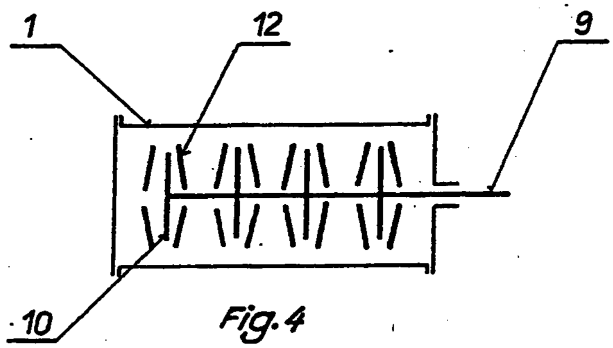


Fig.4

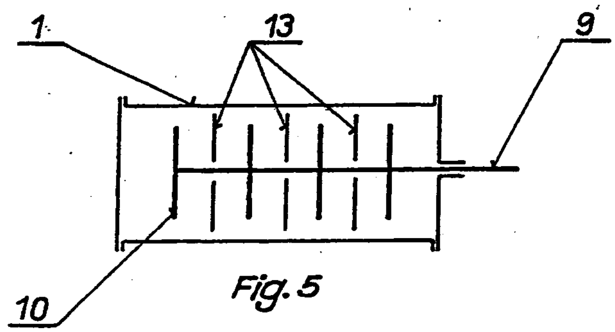


Fig.5

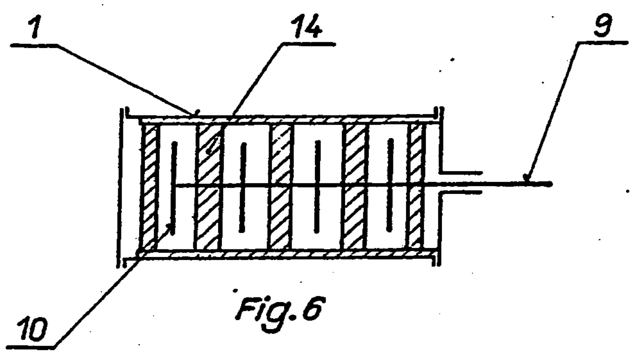


Fig.6

1049685 COMPLETE SPECIFICATION

2 SHEETS This drawing is a reproduction of the Original on a reduced scale

Sheets 1 & 2

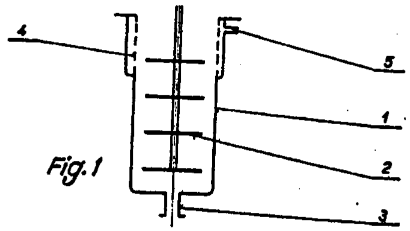


Fig.1

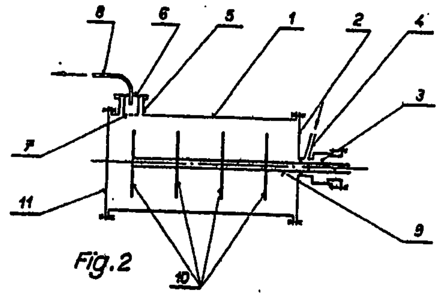


Fig.2

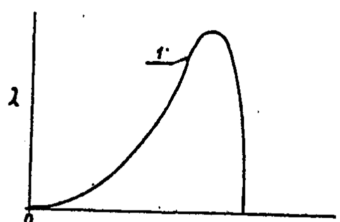


Fig.3

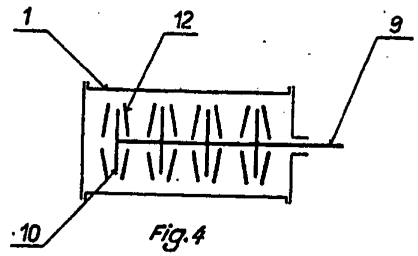


Fig.4

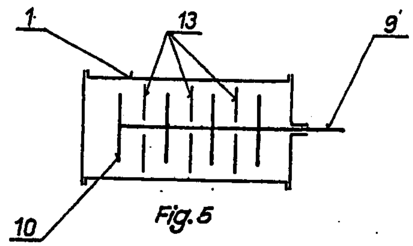


Fig.5

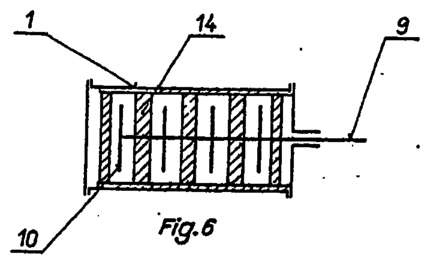


Fig.6